

## Disentangling Ionospheric and Interplanetary Scintillation

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**ASTRON**

A recent MWA paper claimed to see night-side interplanetary scintillation (IPS) in imaging observations at a time cadence of 2s.

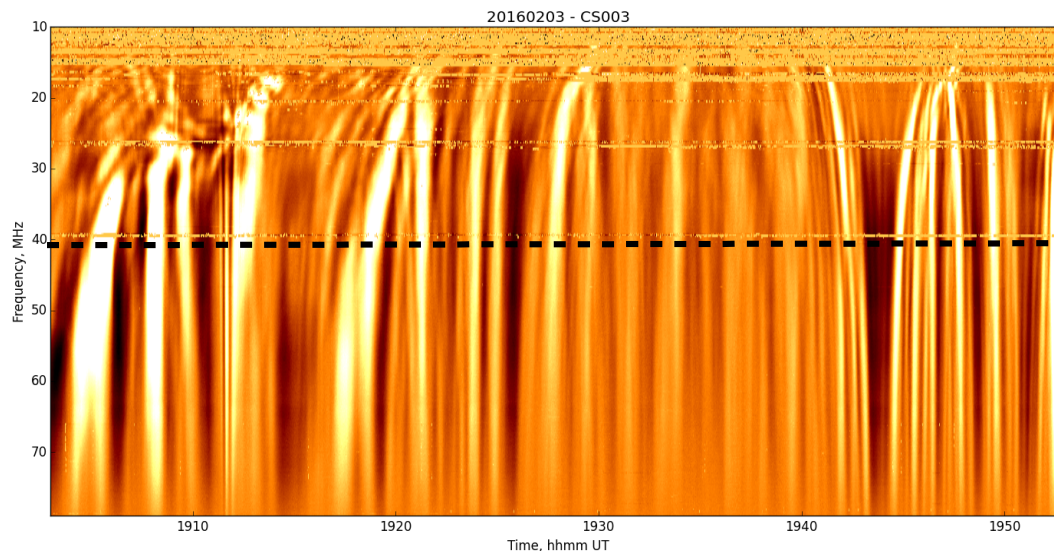
The usual time-scale for IPS is  $\sim 2$ s.

Naturally, this has caused some disquiet in the IPS community.

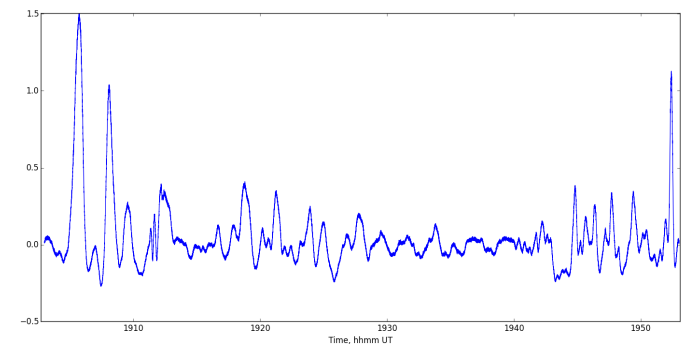
With LOFAR, we can check: can this be IPS? Or is it more likely to be ionospheric scintillation?

# The Advantage of LOFAR

- High time cadence to fully sample the scintillation
- Many stations with a wide variety of baselines
- Ability to record data from each station individually:



Time  
series



Dynamic spectrum

Cas A – 20160203 – 19:03 to 19:53 UT – 1s cadence



Use cross-correlation of time series' to establish the likely origin of the scintillation:

**Ionospheric:** Time lags of several seconds on core station baselines; little correlation on remote station baselines.

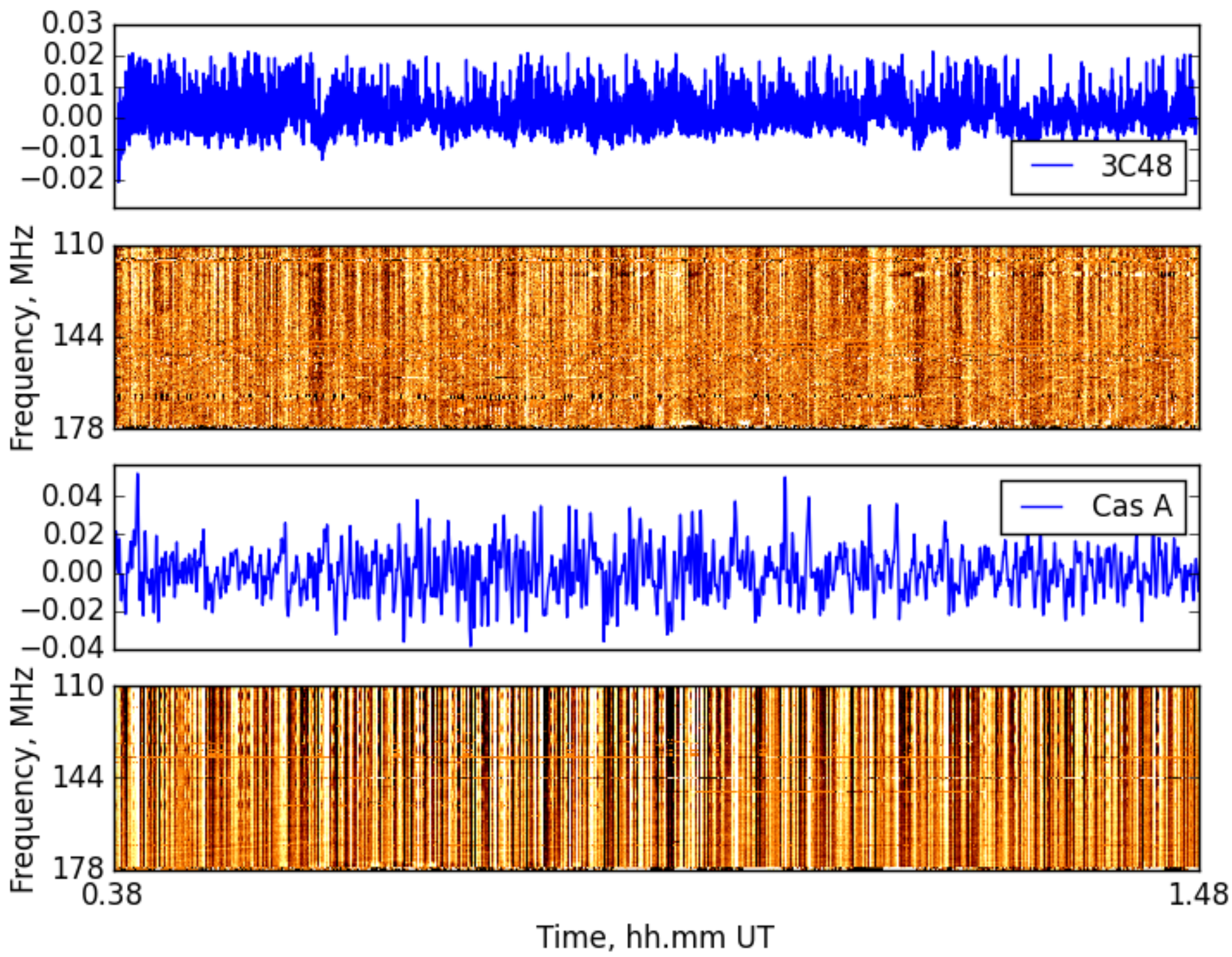
**Interplanetary:** Time lags  $\ll 1$ s expected on remote station baselines; correlation also expected on international station baselines.

In November 2015, a couple of night-time observations of the excellent IPS source 3C48 were taken, using the remote stations.

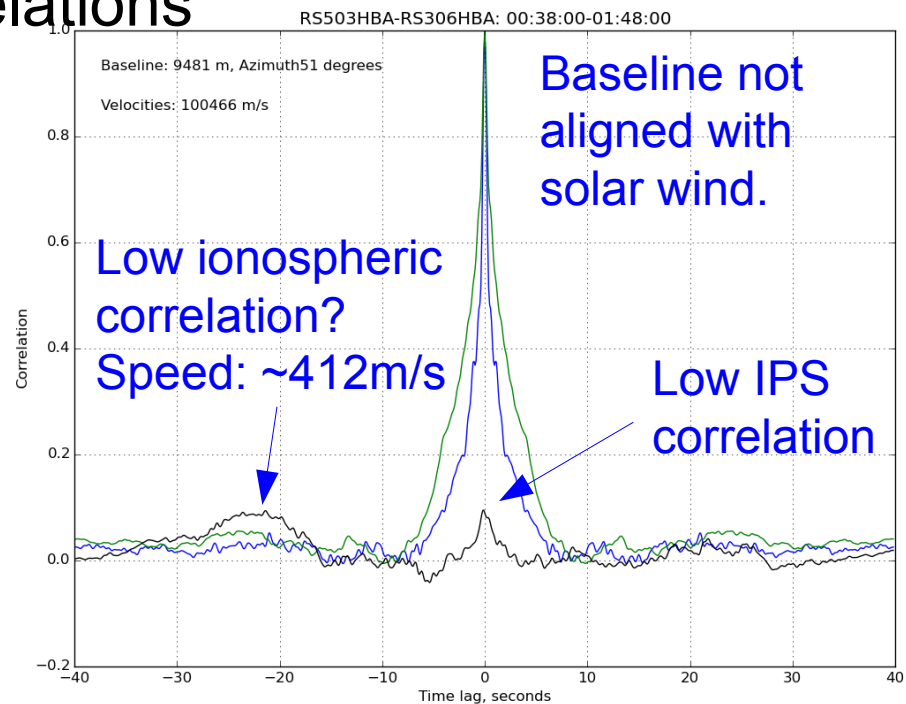
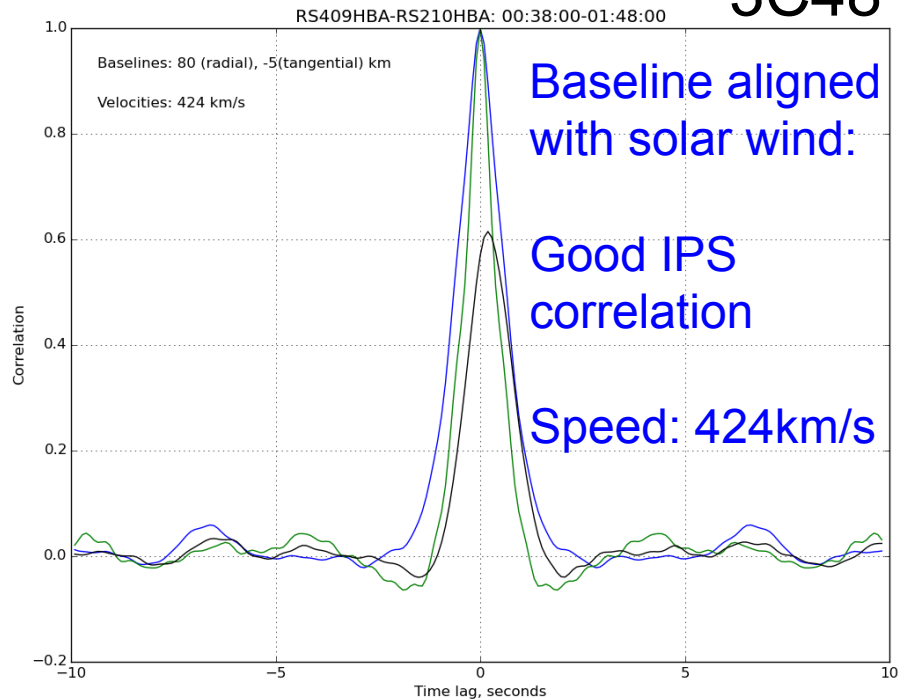
Simultaneously, the core stations looked at Cas A.

Scintillation was seen.

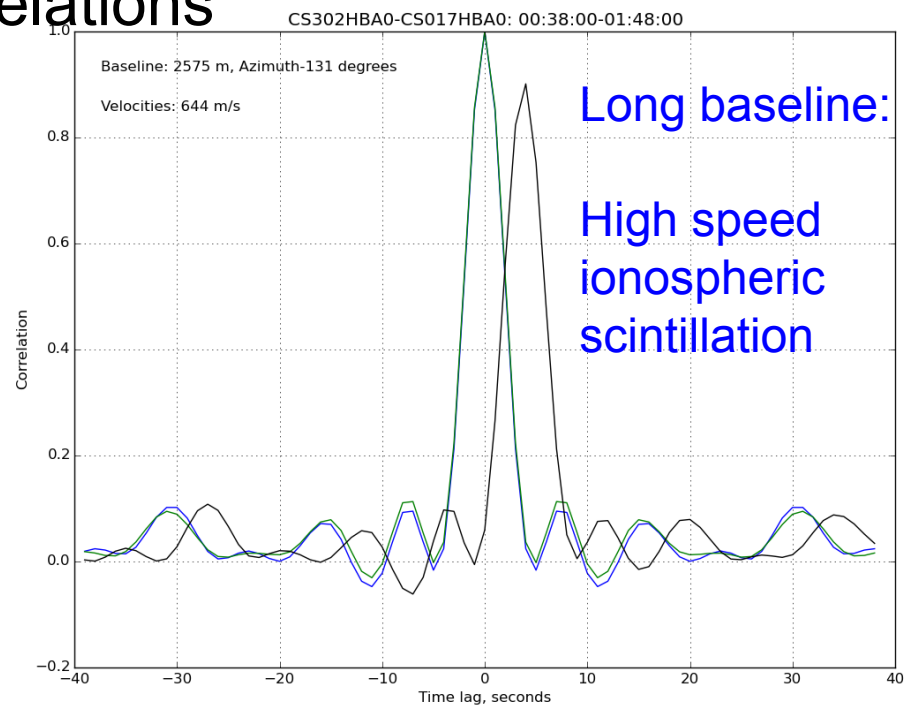
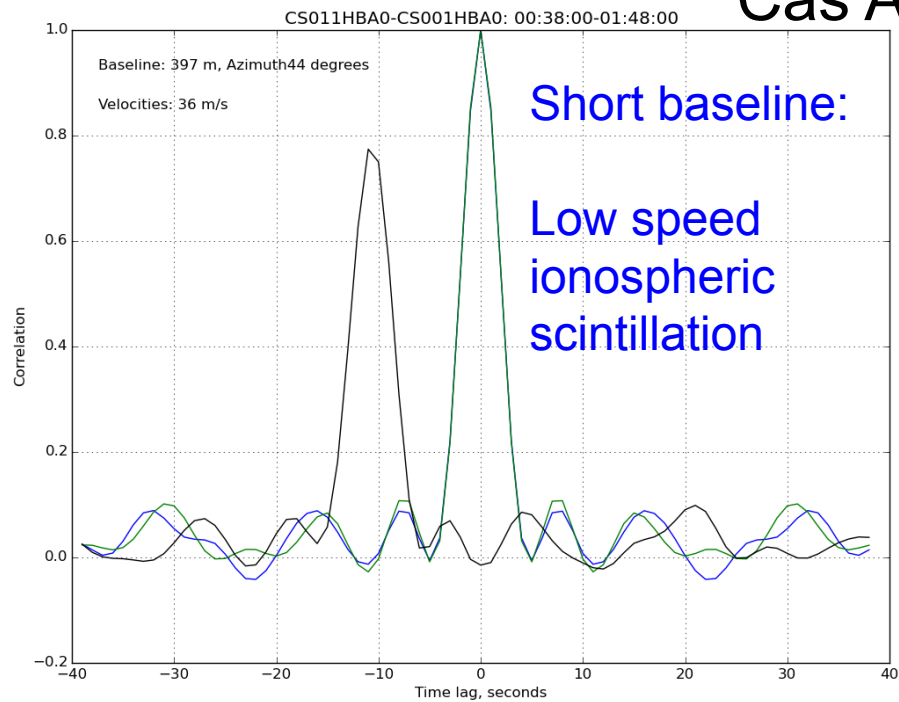




# 3C48 Correlations

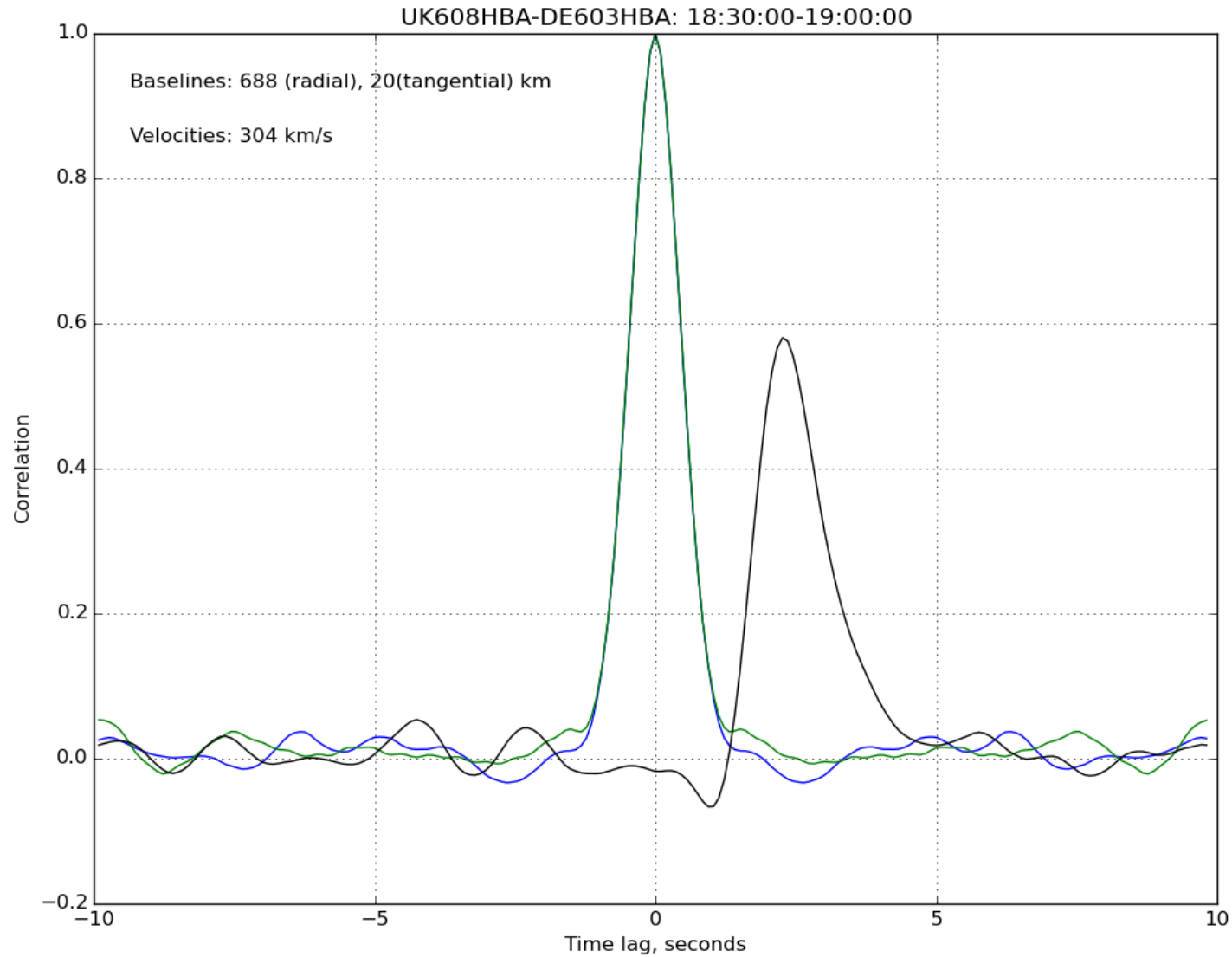


# Cas A Correlations



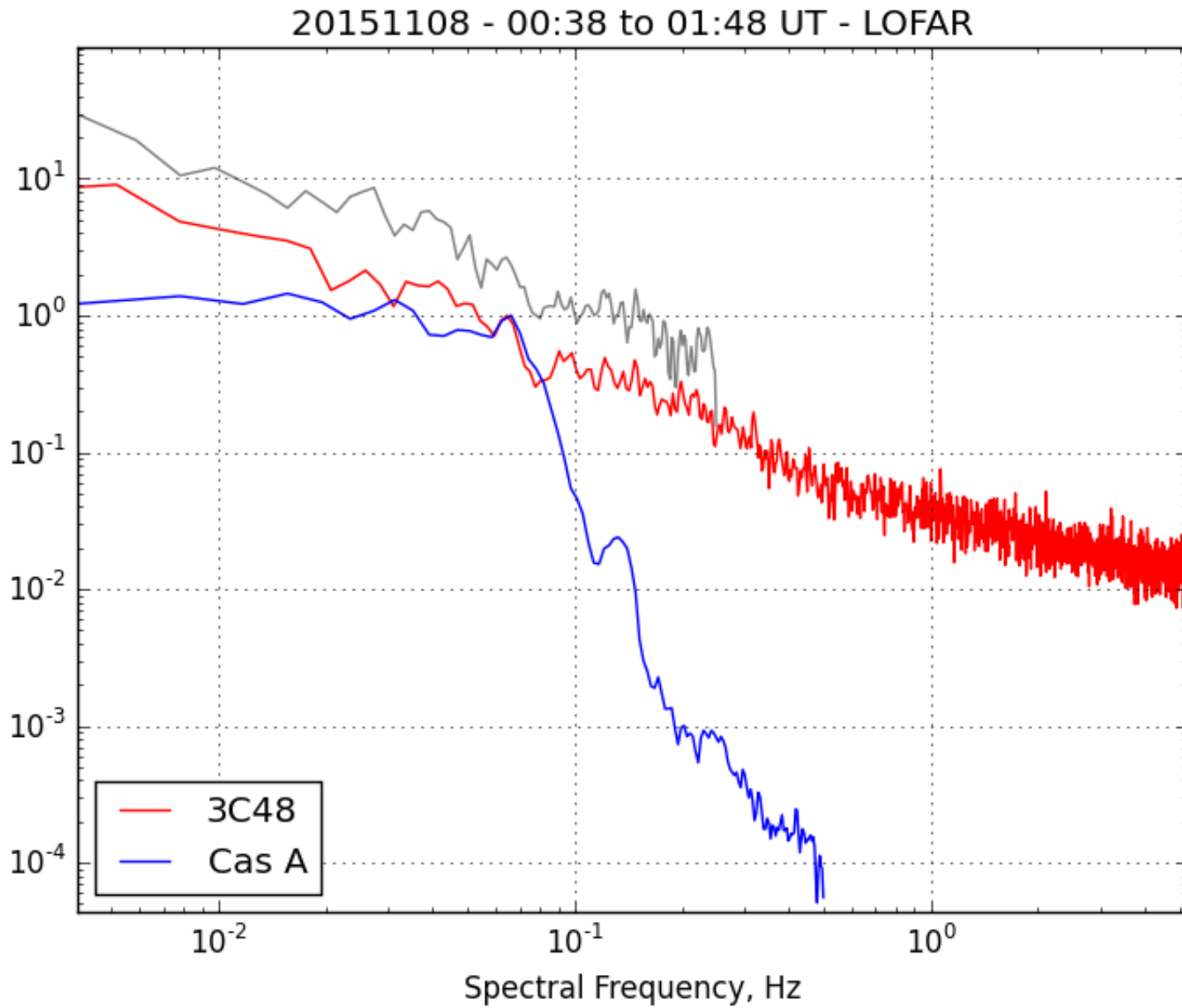


# The First Night-side Long-Baseline IPS Result?



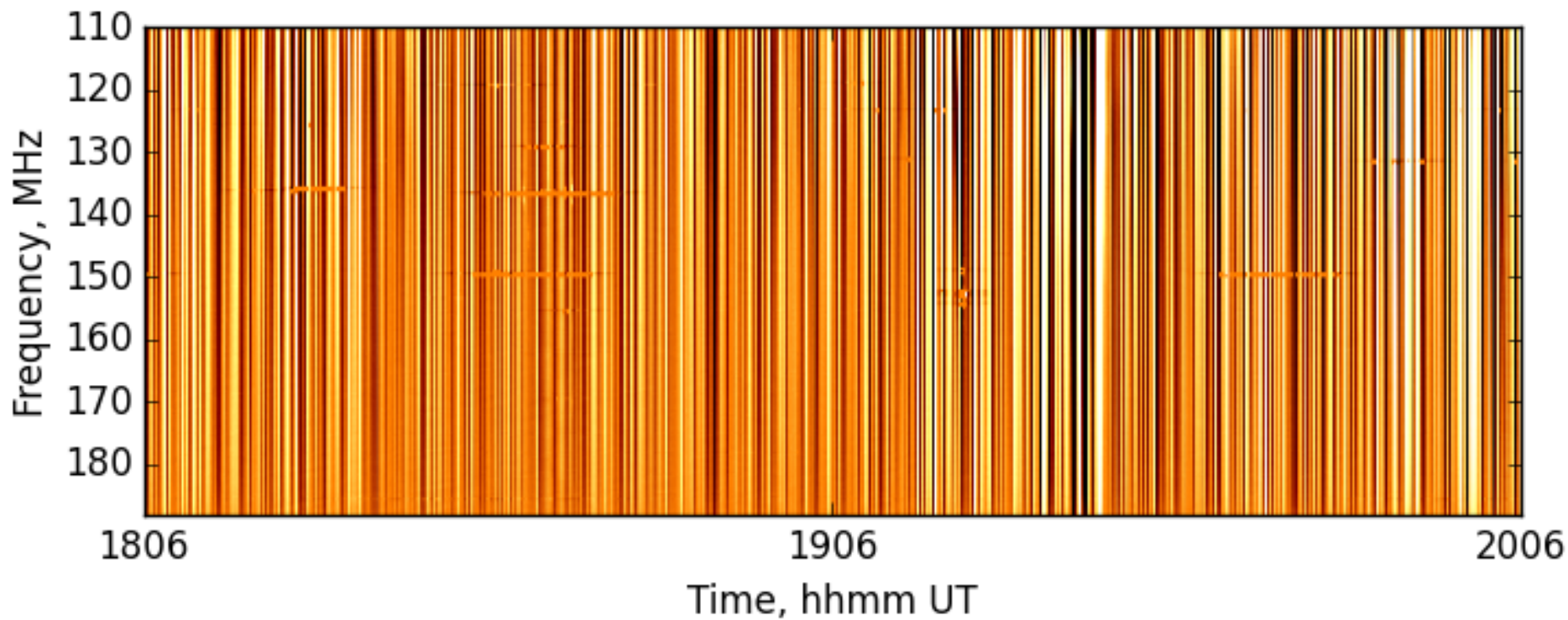
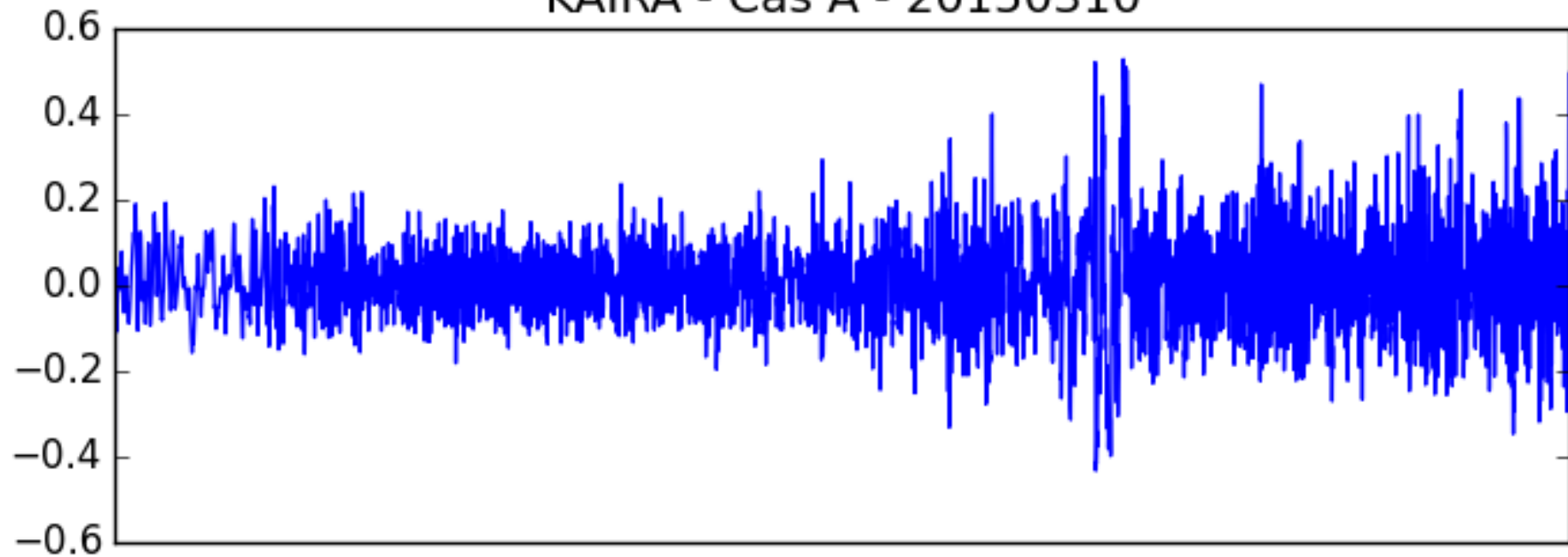
The MWA result was based on power spectra only.  
So can spectra of ionospheric scintillation and IPS  
be easily distinguished?

# Power Spectra

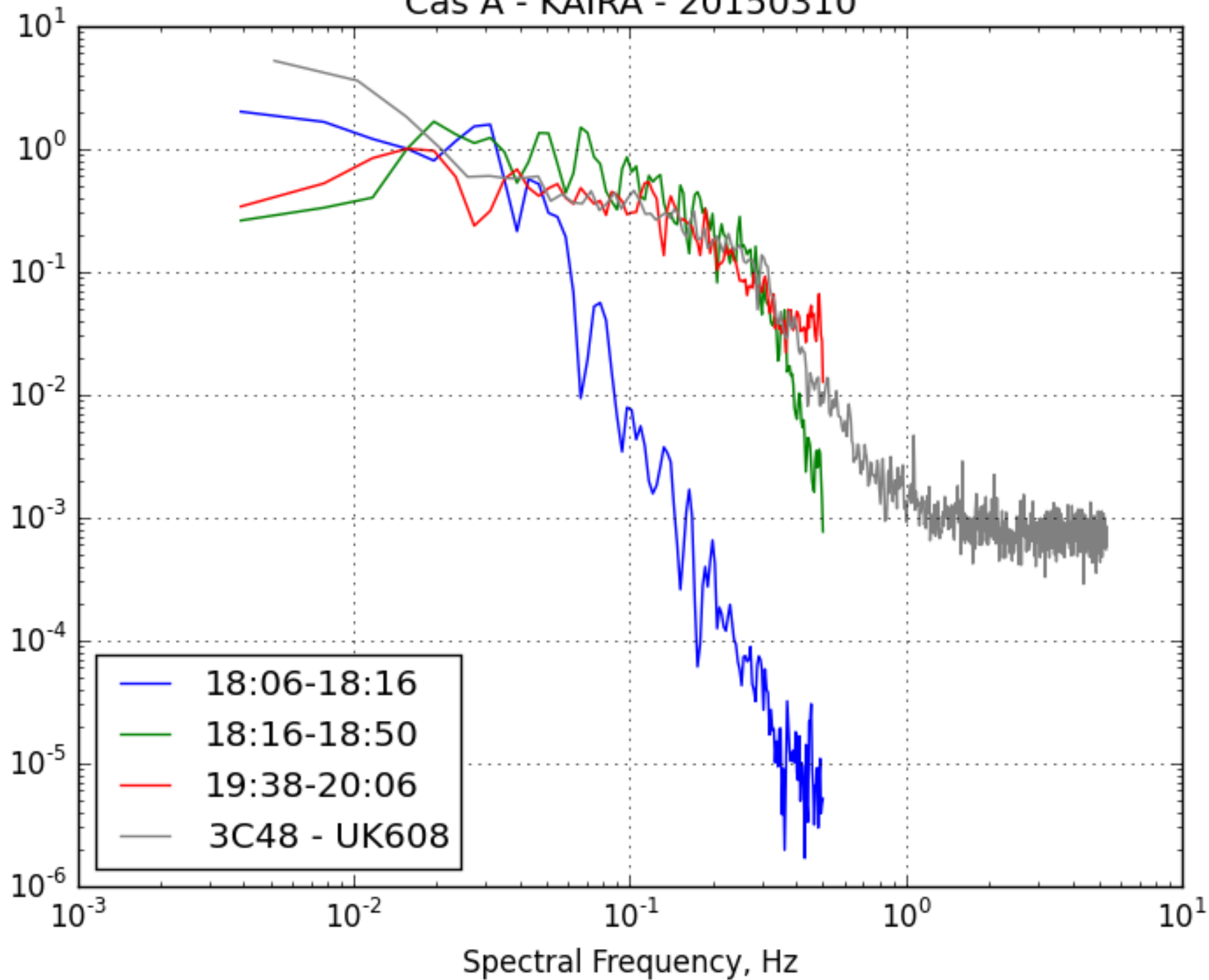


In this example, the power spectra appear distinguishable. But is there ever an occasion when ionospheric and interplanetary scintillation could be confused?

KAIRA - Cas A - 20150310



Cas A - KAIRA - 20150310





There can be occasions when scintillation from both media could be confused. But under what circumstances?

That is a more substantial question and the study is only just beginning.